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A-70178
ESW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

JOHN ZAJAC ET AL.

Serial No. 09/886,654

Filed: June 21, 2001

For: FAST ETCHING SYSTEM AND PROCESS

Examiner: Kin Chan Chin

Art Unit: 1765

CERTIFICATE OF MAILING

I hereby certify that this correspondence and the attached Brief on Appeal (in triplicate) are being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to: Mail Stop Appeal Brief - Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on April 29, 2004.

/Edward S. Wright/
Edward S. Wright

TRANSMITTAL OF APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Transmitted herewith (in triplicate) is applicant's Brief on Appeal in this matter.

A check in the amount of $375.00 is enclosed for payment of this brief and extension fee. The Commissioner is authorized to charge any additional fees or credit any overpayment to Deposit Account 50-2975, Order No. A-70178.

Respectfully submitted,

By /Edward S. Wright/
Edward S. Wright
Reg. No. 24,903

(650) 330-0830

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For: FAST ETCHING SYSTEM AND PROCESS	April 29, 2004

BRIEF ON APPEAL

Edward S. Wright
1100 Alma Street, Suite 207
Menlo Park, CA 94025
(650) 330-0830 (Telephone)
(650) 330-0831 (Facsimile)

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REAL PARTY IN INTEREST

The application currently stands in the names of the inventors. However, it is contemplated that the application may be assigned to Silicon Etch Technology, Inc., a corporation of the State of Nevada, with a place of business in San Jose, California.

RELATED APPEALS AND INTERFERENCES

None.

STATUS OF CLAIMS

The application was originally filed with Claims 1 - 4. Claims 1 and 2 have been withdrawn from consideration, and Claims 3 and 4 are on appeal. The claims have never been amended.

STATUS OF AMENDMENTS

No amendments have been filed since the action from which the appeal is taken.

RELATED APPLICATIONS/PATENTS

None.

SUMMARY OF INVENTION

The invention is a very fast etching process for use in the manufacture and backside etching of silicon wafers and integrated circuit packaging, and in the manufacture of circuit boards.

As illustrated in drawing and described at Page 7, lines 8 - 14, the process is carried out in a chamber 11 with a pedestal 12 on which a wafer 13 or other workpiece is placed. A showerhead electrode 14 is spaced above and parallel to the pedestal, and reagent gases are injected into the chamber through a gas line 16 connected to the showerhead electrode. An RF power source 17 supplies RF energy to chamber to ionize the gas, and gas is pumped out of the chamber through exhaust ports 18.

For silicon etching (See Page 7, line 15 through Page 9, line 21), the electrodes are spaced about 3 mm to 6 mm apart so as to concentrate the power on a small volume of gas. This elevates the plasma density and increases the etching rate. It also provides a more stable and uniform electrical discharge between the electrodes with a given pressure and gases. As noted in the specification, larger

gaps resulted in unstable plasmas uneven etching, with unpredictable etch patterns on the silicon.

The process can be carried out with relatively inexpensive gases such as a mixture of sulfur hexafluoride and oxygen which produce large quantities of fluorine atoms in the electrical discharge for the fast etching rate. Other gases can also be used, as discussed in the specification.

For silicon etching, the process is preferably carried out at a pressure between 1.5 Torr and 10 Torr. This relatively high pressure is important because it greatly reduces the energy of the ions which strike the substrate, thereby reducing undesired sputtering and dislocations in the silicon crystal.

The ratio of the RF power density to the total gas pressure is maintained at a level between about 1.0 and 25 watts/cc per Torr of gas pressure. This results in both a very fast etching rate and a stable plasma. With a power density to pressure ratio of about 3 - 6 Watts/cc per Torr, silicon is etched at a rate of about 7 - 10 microns per minute.

For etching organic materials, the electrodes are spaced about 3 mm to 8 mm apart in order to concentrate the power on a small volume of gas. See Page 9, line 23 to Page 11, line 22. As with silicon, the close spacing of the electrodes elevates the plasma density, increases, the etching rate, and provides a more stable and uniform electrical discharge.

The preferred gas mixture for organic etching in this process is a combination of oxygen or a strong oxidizer such as nitrous oxide and a small percentage of sulfur hexafluoride or fluorocarbon gas. Such gases are inexpensive and produce large quantities of oxygen atoms in the discharge for high etch rates.

The preferred pressure for organic etching is between 2.0 Torr and 15 Torr. Here again, the relatively high pressure is important in reducing the energy of the ions which strike the substrate and thereby preventing undesired sputtering of exposed materials on the substrate.

The ratio of the RF power density to the total gas pressure is maintained at a level between about 0.6 and 20 watts/cc per Torr of gas pressure. This results in both a very fast etching rate and a stable plasma. With a power density to pressure ratio of about 3 - 6 Watts/cc per Torr, epoxy and other organic adhesives are etched at a rate of about 7 - 10 microns per minute.

ISSUE

Whether the Examiner has erred in rejecting Claims 3 and 4 under 35 U.S.C. §103 as being unpatentable over the combination of Aoki et al. (U.S. 5,581,874) and Hubacek (U.S. 6,451,157).

GROUPING OF CLAIMS

It is not acceptable to applicant to have the two claims stand or fall together within the group in which they have been rejected. Claim 4 includes an additional limitation, and the Board could very well find that it is directed to patentable subject matter even if it were to affirm the Examiner's rejection of Claim 3.

ARGUMENT

Claim 3

Claim 3 is directed to a unique combination of steps which results in a very fast process for etching silicon and epoxy resins, namely placing a wafer on a pedestal in a chamber, exhausting gas from the chamber through a pressure regulation valve, introducing a gas containing fluorine and/or oxygen into chamber through a showerhead electrode which is positioned substantially parallel to and less than 6 mm from the pedestal, applying RF power to the pedestal and/or the showerhead electrode, and maintaining the pressure inside the chamber at a level greater than 1.5 Torr. That combination is critical, and it is neither disclosed in nor suggested by the references.

As the Examiner has acknowledged, Aoki et al. fails to teach the exhausting of gas through a pressure regulation valve or the introduction of gas through a showerhead electrode. It also fails to specifically teach or suggest the combination of a showerhead to pedestal spacing of less than 6 mm and a chamber pressure greater than 1.5 Torr. Those are all critical features of the unique combination of steps which makes the invention work so well and separates it from the prior art.

The Examiner attempts to dismiss the failure to teach the absence of a pressure regulation valve by arguing that Aoki et al. teaches the use of an exhaust pump and "therefore, it is obvious the gas is exhausted through a pressure regulation valve." That is utter nonsense. A pump is not a valve, and there is no basis whatsoever for the Examiner's unsupported statement to the contrary. Moreover, the use of a pump certainly does not suggest the use of a pressure regulation valve. Aoki et al. certainly does not suggest replacing the pump with a valve, and adding a

valve to the pump could very well lead to destruction of the pump, *e.g.* if the pump were to continue to operate when the valve is closed. The Examiner's position is without merit.

In support of the idea of incorporating a showerhead electrode from other art into Aoki et al., the Examiner argues that Hubacek teaches that the showerhead electrode can be used for any type of semiconductor processing apparatus wherein it is desired to distribute process gas over a semiconductor substrate. Significantly, however, the list of applications identified by Hubacek for the use of a showerhead electrode includes CVD systems, ashers, capacitive coupled plasma reactors, inductive coupled plasma reactors, and ECR reactors (Col. 4, lines 43 - 45), but it fails to mention the etching of silicon or epoxy resins. Hence, contrary to the Examiner's suggestion, Hubacek fails to teach or even suggest the use of a showerhead electrode in the invention to which the claims on appeal are directed.

Moreover, substituting a different type of electrode for the one shown in Aoki et al. would upset the dimensional and pressure relationships, and the electrode spacing and pressure taught by Aoki et al. would no longer be applicable.

Finally, it should be noted that Aoki et al. fails to teach the specific combination of an electrode spacing of less than 6 mm and a pressure greater than 1.5 Torr in a process for etching silicon and epoxy resins. In suggesting a spacing of 3 to 20 mm, Aoki et al. fails to recognize the desirability of the relatively close spacing of the electrodes in applicant's invention and actually teaches away from it. Likewise, in suggesting pressures in the range of 1 micro Torr (10^{-6} Torr) to several Torr, Aoki et al. fails to recognize the importance of keeping the pressure above 1.5 Torr and once again teaches away from it.

Claim 4

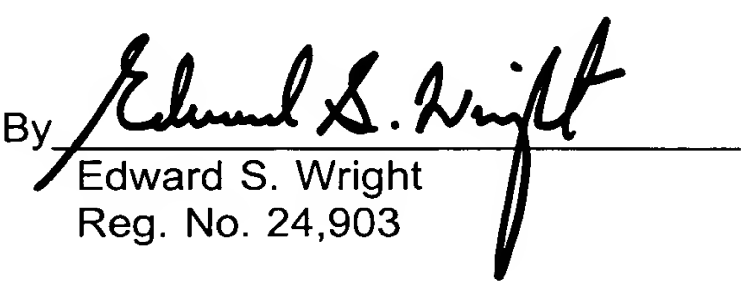
Claim 4 depends from Claim 3 and is directed to patentable subject matter for the same reasons as its parent claim. In addition, it further distinguishes over the references in specifying that the ratio of the RF power provided between the showerhead electrode and the pedestal to the gas pressure is greater than 1 Watt per cubic centimeter to each Torr of gas pressure. As the Examiner has acknowledged, this power density to pressure ratio is not taught by the references, and there is no basis whatsoever for the Examiner's suggestion that it is merely a matter of routine experimentation within the prior art. Combining the teachings of the references in the

manner suggested by the Examiner and then experimenting with power density to pressure ratios would not produce fast etching of silicon or epoxy resins, and it certainly would not lead to the ratio set forth in Claim 4.

SUMMARY AND CONCLUSION

It is respectfully submitted that the rejection which the Examiner has made cannot be sustained and that the action of the Examiner should be reversed.

Respectfully submitted,

By 

Edward S. Wright
Reg. No. 24,903

(650) 330-0830

The Claims on Appeal

3. A process for very fast etching of silicon or epoxy resins, comprising the steps of:

placing a wafer on a pedestal in a chamber;

exhausting gas from the chamber through a pressure regulation valve;

introducing a gas containing fluorine and/or oxygen into chamber through a showerhead electrode which is positioned substantially parallel to and less than 6 mm from the pedestal;

applying RF power to the pedestal and/or the showerhead electrode; and

maintaining the pressure inside the chamber at a level greater than 1.5 Torr.

4. The process of Claim 3 wherein the ratio of the RF power provided between the showerhead electrode and the pedestal to the gas pressure is greater than 1 Watt per cubic centimeter to each Torr of gas pressure.

Appendix A